
I. *A Letter from Mr* Anthony van Leeuwenhoek, *F.R.S. Containing his Obſervations upon the Seminal Veſſels, Muſcular Fibres, and Blood of Whales.*

Delft in *Holland*, March 1. 1712.

I Have formerly affirm'd, that the *Animalcula in Semine Maſculino* of a Horſe, and thoſe of a Dog, are of one and the ſame bigneſs; at leaſt, that they appear'd ſo to me thro' the Microſcope.

Since which time I have been very deſirous to obſerve the *Semen Maſculinum* of a Whale, in order to diſcover, if it were poſſible, whether the *Animalcula* in thoſe great Creatures did not proportionably exceed ſuch as I have diſcover'd in ſmaller Creatures.

Having therefore made an Acquaintance with one *Iſaac van Krimpen*, who had for many Years been concern'd in the Whale Fiſhery, as Commander of a *Greenland* Ship; and he being an obſerving Man, I intreated him that he would give me a piece of the *Penis* of a Whale, *viz.* of the thickeſt part of it, where it was joyn'd to the Body, in hopes that I might ſtill diſcover ſome of the *Animalcula* that were in the *Vaſa deferentia.*

The Captain accordingly help'd me to ſuch a piece; but in the hanging it up, and ſtretching and drying it, I believe the *Semen Maſculinum* was run out of it, becauſe he had hung up and dry'd that Member, in order to get Train Oyl out of it. Having open'd the *Vas Seminale* as well as I could, for it was very much dry'd up, and ſcraped off a little of the Matter that was in it

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with a ſmall Knife, I mix'd it with a little Rain Water, in order to ſeparate the Parts from one another: Whereupon I obſerv'd in the ſaid Matter a great number of long four-ſided Particles, moſt of them having 4 Right Angles, but of different ſizes, and many of 'em were three times as long as they were broad; but I ſaw none of 'em ſo broad as the Diameter of the Hair of a Man's Head, and the ſmalleſt was a hundred times leſs, in ſome few of which I could perceive no thickneſs.

All the ſaid Particles, or little Figures, were as clear as Cryſtal, ſo that I concluded that they were fix'd Salts; and the rather, becauſe they were ſo hard, that they were not diſſolv'd in the Water. And when this Matter, which I had ſcrap'd out of the Veſſels of the Whales *Penis*, had lain a little longer in the Water, I diſcover'd Salt Particles; the two longeſt ſides of which run parallel to each other, but the two ſhorteſt Sides oblique; ſo that one end of 'em had a ſharp, and the other an obtuſe Angle: And tho' the Salt Particles had lain at leaſt a Week in Water that was frozen, and the ſame Water afterwards diſſolv'd, yet I ſaw the Salts floating in it.

As many Obſervations as I made, I could not diſcover the leaſt Particle that bore any reſemblance to the *Animalcula in Semine Maſculino.*

The ſaid Captain having inform'd me, that the Teſticles of a Whale are as big as a Firkin of Butter that weighs about a hundred Weight, I intreated him the next Whale he took, to cut off the *Vaſa Semen deferentia* as near the Teſticles as he could, and to lay them a drying upon a Plank, or to let the Surgeon do it, whom they have always on board, and who is fitteſt for ſuch a work; for by that means I hop'd to diſcover the *Animalcula* therein: But as yet my Requeſt has not been comply'd with.

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The ſame Perſon told me, that he had never found but one young Whale in the Belly of the Mother, and that was in a Whale which he had taken; the Body of which burſting open ſome Days afterwards, there came out a young Whale that was Fifteen Foot long; but he could not tell, whether they were Feet conſiſting of Eleven, or of Twelve Inches.

About two Years ago there came a Stranger to me, who had two *Penis's* of the Whale Fiſh; and I took the liberty to ask him of what uſe thoſe Members were; but he made me no other Anſwer, than that they were uſed in Phyſick. Soon after came the aforeſaid Captain to me, and preſented me with ſome Slices of a Whale's *Penis*; adding, that a little of it grated, or cut into ſmall Pieces, and boil'd in Milk or Beer, was very good againſt the *Bloody Flux*, and that a Neighbour of his, who had been ill of that Diſtemper a whole Year, was cur'd by the ſame Medicine.

The ſaid Captain told me alſo, that the Female of a Whale (on the ſide of the *Uterus*, but a little nearer its Tail) has two Nipples, or Teats, which yield Milk, and that he had drank thereof; and he ſhow'd me the Teats, the Diameter of one of which was no more than an Inch and a half, and it was two Inches long, but it was dry'd hard.

I intreated the Captain when he return'd again to the Whale-fiſhing, to bring me ſome of the Fleſh of a Whale that had been dry'd in the Air; becauſe that which had been provided for me before, ſtunk very much, and was almoſt rotted, and ſo was not fit for my purpoſe.

He brought me two pieces of hard dry'd Fleſh, of the length of a Span, and of the thickneſs of ones largeſt Finger. They were as black as Pitch; but, as he ſays, when the Fleſh was cut off, it was red. From the blackneſs of it I concluded, that the Blood was of a deep or dark Red; which the Captain alſo confirm'd; adding, that where the Blood fell, it left a Stain.

I cut through the Fleſh both croſs and length-ways, in order to diſcover the thickneſs of its Particles; and after I had cut thin Scales a-croſs, they appear'd of a bright red Colour; but when I cut them thicker, they were of a dark Red; and when very thick, they were blackiſh. In this Operation I obſerv'd, that the ſmall Fleſhy Muſcles were ſurrounded with very thin Fibrous Particles, that look'd like little Membranes torn to pieces: And upon ſeveral Parts of theſe little Membranes, there lay Fat, which, when there is a quantity of it together, they call the Train; and theſe Train Particles lay preſſed together in the ſame manner as I have formerly deſcribed thoſe of an Oxe; nor were they bigger than the Particles of the Fat of an Oxe; and many of theſe Particles were like melted Fat; inſomuch, that when I ſqueez'd the Fleſh, the Fat came out at the end of it.

I laid a ſmall part of this Fleſh, after that I had cut it into little pieces, in Water; and I obſerv'd that the Fleſh was thinner when it was dry, than when it was ſoak'd through: and in comparing the Fleſh of a Whale with the Fleſh of an Oxe, I judged that the Particles of the former were finer than thoſe of the latter.

Now, in order to demonſtrate the fineneſs or ſlenderneſs of the Parts of the Fleſh, length-ways, of ſo great a Creature as the Whale is (for this was above 50 Foot long) I placed one of the Hairs of my Beard by one of the Fleſh Particles of the Whale, and I judg'd that the ſaid Hair was at leaſt Nine times thicker than one of thoſe which I may call a little Fleſh Muſcle, it being again compoſed of other long Particles or Fibres.

I could not aſcribe either a round or Sexangular Figure to theſe little Fleſh Muſcles of the Whale, becauſe they lay ſo compreſs'd in one another, that they appear'd in ſeveral Shapes, but moſt of 'em were inclining to a Sexangular: And when I view'd them more curiouſly at their ends, I obſerv'd for the moſt part that one Fleſh Particle was wrapt up in ſix others, but not regularly, for one took up more place than another; inſomuch, that ſometimes the outward Fleſh Particle did not touch the inward but in one point.

When I cut the afore-mention'd long ſlender Fleſh Particles, either acroſs or obliquely with a ſharp Knife, I could ſee therein a vaſt number of exceeding ſmall Particles, of which one of thoſe Fleſh Particles did conſiſt, and they were alſo cut a-croſs: And through the Microſcope it appear'd to me juſt as if one ſhould ſee with the naked Eye ſmall Grains of Sand lying upon them; and I alſo could diſcover the ends of them. In theſe my Obſervations there appear'd to me a great many Fleſh Particles, ſurrounded with little Figures like Rings, and very cloſe to one another, juſt as if you ſhould take a common Iron Wire, and twiſt it about with another very fine one: And ſuch circular Fleſh Particles have I formerly obſerv'd in the Muſcular part of the Paw or Foot of an Gnat; but the Rings were cloſer to one another in the Fleſh Particles of a Whale, than in thoſe of a Gnat; and if I remember right, the Fleſh Particles (or Fibres) of a Gnat, were as thick as thoſe of a Whale. How wonderful are ſuch Contextures!

From the ſaid Obſervations one may more firmly conclude, that when the Muſcles are ſtretch'd out, the Fleſh Particles have no Wrinkles; and that when they lye in their natural Poſition, then the Fleſh Particles have Wrinkles

I was above meaſure aſtoniſh'd at theſe my Obſervations, having always imagin'd, that the Fleſh Particles of very great Creatures, ſuch as the Whale is, ſhould have been compoſed of greater Parts, in proportion, than others.

In theſe Diſcoveries it was very remarkable, that each of the before-mention'd long Fleſh Particles appear'd to me as if they were wrapt about with a little thin Membrane, which I obſerv'd in a thouſand ſeveral Places; and the more eaſily, becauſe as the Fleſh Particles grew dryer, theſe fine Skins or Membranes were ſeparated from them.

The afore-mention'd Captain acquainted me, that the Whale has three diſtinct Skins; the uppermoſt of which is very thin, and the next to that is as ſoft as Velvet; but the third and undermoſt is a thick Skin, which we call the *Sward*, and is like the Skin of a Hog. Soon after he gave me a little piece of the firſt Skin, which he ſaid was eaſily ſeparated from the ſecond; it was no thicker than a Leaf of Writing Paper. Having view'd that Skin thro' a Microſcope, I judg'd it to be compoſed of ſuch flattiſh Particles as I can call by no other Name than little Scales, and which were no bigger than the little Scales of which our own outmoſt Skin is compos'd: But whereas the Scales of our Skin are very eaſily ſeparated, and eſpecially the uppermoſt Scales, which are ſhed or caſt often, the little Scales of the Skin of the Whale are firmly united together.

When I came to conſider the aforeſaid Skin, with regard to its thickneſs, I judg'd it to be compoſed of not fewer than four Skins, lying upon each other: But when I view'd the ſame more nicely, I diſcover'd, that there were at leaſt twenty Skins upon one another; all which were compoſed of little Scales, and of exceeding ſmall Particles that lay ſcatter'd under thoſe Scales; but as carefully as I examin'd the ſaid Skin, I could not diſcover in it the leaſt Fibres or Veſſels.

From theſe Obſervations I concluded, that the aforeſaid uppermoſt Skin was ſeparated of itſelf from the reſt; which the Captain alſo confirm'd; adding moreover, that he gave but one cut or ſlit in the uppermoſt Skin.

Skin, and then twiſting it about a round Stick of Wood, it came very eaſily off from the ſecond Skin.

In ſeveral of my Obſervations I did diſcover, that there were a great many Salt Particles, moſt of them of the Colour of Aſhes, ſhut up in the outmoſt Skin; but I ſeparated them from it by Rain Water. Theſe Salt Particles were twice as long as they were thick, having each of them four Right Angles; they lay coagulated in a very clear thin Liquor, which did not evaporate or melt away in rainy Weather: From whence I concluded, that they were nothing but common Sea Salt.

Moreover, I obſerv'd a great number of very ſmall Salt Particles, that were about as long as the former, but exceeding ſlender.

I got alſo a piece of the ſecond Skin of a Whale, about as broad as my Hand, which was as black as Pitch, and had four or five Protuberances or Bumps on it, that were about as big as the third part of a Pea; and which, I was told, were occaſion'd by the biting of the Lice, of which there were great Numbers upon the Whales Body.

This Skin was dry'd hard, and was almoſt half an Inch thick; but it was not ſtrong, becauſe there were no Veſſels or Sinewy Fibres running through each other, as in the Skins of Beaſts and our common Fiſh; only there were ſome ſmall Fibres that joyn'd it a little to the Skin that lay under, and which paſs'd, as it were, in a Right Line to the uppermoſt Superficies of the Skin. Theſe Strings, or Fibres, were ſo cloſe to one another, that there was not above the breadth of two or three Hairs between them; they were tranſparent or whitiſh, and in one of them I could diſcover a Blood Veſſel.

The undermoſt, or third Skin, was whitiſh, and ſo ſtrong withal, that I concluded, that in caſe the Harping Iron was ſtruck ſo deep into the Whale, that the Beard or Hooks thereof did penetrate into the aforeſaid white or third Skin, it would keep its hold; but if it went no farther than into the black Skin, it would eaſily be torn out.

I have done my utmoſt Endeavour to diſcover the Parts of the aforeſaid black Skin, but could not do it to my Satisfaction; for when I cut it very thin, I judg'd it to be full of a great many ſmall Pores or Openings, and that upon this account it was not ſo heavy as I ſuppoſed a cloſe ſolid Body ought to be; and I ſaw in it little black ſpots ſtanding ſo near one another, that you could hardly thruſt a Hair between; and theſe Spots were the cauſe of its being lighter. So have I obſerv'd in the Skins of Beaſts, in many places, between the Parts of which the Skin is compoſed, a great number of little Globules, which I found to be Fat; but in the aforeſaid Skin I could diſcover no Fat; which appear'd very ſtrange to me, becauſe it is well known, that Whales have 10, 14, 15, or more Inches thickneſs of Fat (which they call Bacon) under the third Skin.

Moreover I obſerv'd, that the black Skin was clammy, or Glutinous, when it was wet; from whence I concluded, that People might draw a very good Glue from it.

From the black Skin and black Blood of a Whale, I turn'd my Thoughts to the black Blood of a Salmon; and ſuppoſed, that the redneſs of the Fleſh of that Creature, was alone occaſion'd by the blackneſs of its Blood; and that in like manner the blackneſs of the Fleſh of Whales proceeded from the ſame Cauſe.

From hence I was conſidering, whether the blackneſs of the Men upon the Coaſt of *Guinea*, might not alſo proceed from their black Blood; and whether alſo their Fleſh might not be blacker than that of white Men, and that the blackneſs of their Skin alone depended upon their black Blood; which deſerves to be conſider'd.

Now ſince we ſee that the Particles of Fleſh, Fat, and little Membranes of the Whale, are no bigger than thoſe of an Oxe, and that the bigneſs of Creatures does alone depend on the Number or Quantity of their Parts, we may eaſily conceive why the *Animalcula in Semine Maſculino* of a Whale, are not bigger than thoſe in our common four-footed Creatures.

As for what belongs to the Fat of a Whale, which we call Bacon, and out of which we boil the Train-Oyl, I found the Parts as Fluid as thoſe of the Fat of our River Fiſh; for I have often view'd with a Microſcope the Fat of an Ell, and took a great deal of Pleaſure in obſerving the Globular Particles, which lay, as it were, compreſs'd in one another; but my Pleaſure was very Tranſitory, by reaſon of the Fluidity of thoſe Parts.

Thus You have what I thought proper to communicate to you, and remain with great Reſpect,

Your Humble Servant,

Anthony van Leeuwenhoek
